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A novel method to develop an otolith microchemistry model to determine striped bass habitat use in the San Francisco Estuary

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Otolith Sr/Ca has become a popular tool for hind casting habitat utilization and migration histories of euryhaline fish. It can readily identify habitat shifts of diadromous fish in most systems. Inferring movements of fish within estuarine habitat, however, requires a model of that accounts of the local water chemistry and the response of individual species to that water chemistry, which is poorly understood. Modeling is further complicated by the fact that high marine Sr and Ca concentrations results in a rapid, nonlinear increase in water Sr/Ca and $^{87}\text{Sr}/^{86}\text{Sr}$ between fresh and marine waters. Here we demonstrate a novel method for developing a salinity-otolith Sr/Ca model for the purpose of reconstructing striped bass (*Morone saxatilis*) habitat use in the San Francisco Bay estuary. We used correlated Sr/Ca and $^{87}\text{Sr}/^{86}\text{Sr}$ ratios measurements from adult otoliths from striped bass that experienced a range of salinities to infer striped bass otolith Sr/Ca response to changes in salinity and water Sr/Ca ratio. Otolith $^{87}\text{Sr}/^{86}\text{Sr}$ can be assumed to accurately record water $^{87}\text{Sr}/^{86}\text{Sr}$ because there is no biological fractionation of Sr isotopes. Water $^{87}\text{Sr}/^{86}\text{Sr}$ can in turn be used to estimate water salinity based on the mixing of fresh and marine water with known $^{87}\text{Sr}/^{86}\text{Sr}$ ratios. The relationship between adjacent analyses on

otoliths of Sr/Ca and $^{87}\text{Sr}/^{86}\text{Sr}$ by LA-ICP-MS and MC-ICP-MS ($r^2 = 0.65$, $n = 66$) is used to predict water salinity from a measured Sr/Ca ratio. The nature of this non-linear model lends itself well to identifying residence in the Delta and to a lesser extent Suisun Bay, but does not do well locating residence within the more saline bays west of Carquinez Strait. An increase in the number of analyses would improve model confidence, but ultimately the precision of the model is limited by the variability in the response of individual fish to water Sr/Ca.

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